Psychometric tests and a complex assessment of the course of alcohol dependence

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1. Abbreviations

AAG: Alcoholics Anonymous Groups
AAS: Addiction Admission Scale
AD: Alcohol dependence
ADPs: Individuals with alcohol dependence
ANOVA: Univariate analysis of variance
APS: Addiction Potential Scale
ASI: Addiction Severity Index
AUDIT: Alcohol Use Disorders Identification Test
BDI: Beck Depression Inventory
C: Cooperativeness
DM: Decision-making
DTG: Detoxification group
EPDS: Edinburgh Postnatal Depression Scale
HA: Harm avoidance
IGT: Iowa Gambling Task
LTA: Long-term abstinence
MAC-R: MacAndrew Alcoholism Scale – Revised
MANCOVA: Multivariate analysis of covariance
MM: Minnesota Model
MMPI: Minnesota Multiphasic Personality Inventory
MW: Mann Whitney Test
NS: Novelty seeking
P: Persistence
RD: Reward dependence
ROC: Receiver operating characteristic analysis
SADQ: Severity of Alcohol Dependence Questionnaire
SCID: Structured Clinical Interview for DSM-IV I Axis Disorders
SD: Self directedness
SPSS: Statistical Package for Social Sciences
SSS: Sensation Seeking Scale
ST: Self-transcendence
STA: Short-term abstinence
STAI: State-Trait Anxiety Inventory
TCG: Therapeutic community group
TCI: Temperament and Character Inventory

2. Brief summary

In order to understand the course of alcohol dependence (AD) more deeply, carefully selected and psychometrically evaluated psychological tests are essential. In recent decades, few psychometric tests have been widely and systematically standardized on Hungarian samples. Nevertheless, this tendency seems to be changing as more and more psychometric data are becoming available. This work in certain aspects relates to this tendency. In the light of different psychological tests, psychometric indices have been presented for direct and indirect indicators of the severity of AD. It has been confirmed on a Hungarian sample that the assessed and applied severity measures are reliable and valid. On the other hand, these different symptom severity indicators have been connected to personality factors so as to extend our knowledge on patients with more severe forms of addiction. It was revealed that novelty-seeking (NS) is the strongest correlate of the severity of the clinical symptomatology of AD, and this personality factor is the most powerful determinant of a severe AD. Self directedness (SD) as a personality factor is a robust determinant of an existing AD and the ability to sustain abstinence. For a better understanding of long term abstinence an integrative approach was applied by combining neurocognitive and personality measures. A decision-making deficit was detectable even after long-term alcohol abstinence and it is concluded that a more adaptive personality profile can contribute to the compensation of this trait-like neurocognitive deficit in sustained sobriety. A comparison of different alcohol treatment settings revealed that, in the context of 12-step-based interventions, an enhancement of spiritual orientation could be a favourable treatment aim for patients with AD, since spirituality serves as a mediating factor within the treatment, and as such, decreases state anxiety.

3. Introduction

3.1. Significance of clinical psychometrics

The study of human behaviour is one of the essential elements of psychology. During recent decades, several major branches of applied psychology have emerged: psychologists use tests in hospitals and other clinical settings to assess neurocognitive performance and personality domains, health psychologists use tests and surveys in a variety of medical settings, forensic psychologists use tests in the legal system and child psychologists use tests to assess childhood disorders (Kaplan and Saccuzzo, 2013). Psychological tests measure many different types of behaviour, and there are therefore many types of tests: there is a clear distinction between ability tests and personality tests. The items in ability tests are indicators of speed, accuracy, or both. Personality tests are related to the overt and covert dispositions of the individual; traits and temperaments (Kaplan and Saccuzzo, 2013). Psychometric tests are also applicable for the screening of mental health-related problems and to assess the severity of clinical states. In order to establish objective psychological testing, the measurement of a phenomenon that is not directly quantifiable must be defined. This process is called operationalization (Rózsa, 2009). Psychological/psychometric testing enables clinicians and researchers to operationalize the dimensions of intelligence, personality and the symptoms that reflect clinical conditions. This promotes a better understanding of individual problems and diseases and the development of intervention strategies for psychological/psychiatric disturbances.

 "Psychometrics, or quantitative psychology, is the disciplinary home of a set of statistical models and methods that have been developed primarily to summarize, describe, and draw inferences from empirical data collected in psychological research" (Jones and Thissen, 2007). Since the 19th century, several assessment techniques have been described and continuously facilitate a closer understanding of mental health indices and neurocognitive and personality functioning in several areas of human behaviour. However, psychological testing in the field of psychiatry suffers a wide range of measurement problems, including case identification; assessment of the severity of a disorder; assessment of personality domains, mood disturbances, intellectual (neurocognitive) performance and behavioural activity; and

assessment of the outcomes of treatment (Gilbody et al., 2006). A psychometric test measures only a sample of behaviour, and test scores are therefore not perfect measures of characteristics or behaviour, and the possibility of errors always has to be considered (Kaplan and Saccuzzo, 2013). It can be concluded that, in the selection of a measure, scientific substantiation and appropriate psychometric characteristics should be weighed (Rózsa, 2009).

In psychological/psychometric testing, reliability and validity are the most important questions regarding the goodness of operationalization. The repeatability of measurement reflects to reliability, while the test validity shows the degree to which it measures what it is supposed to measure (Rózsa, 2009). Generally, this can be confusing because it implies that there are sole indices of reliability and validity (Gilbody et al., 2006).

In the following sections, different indices of reliability (consistency) and validity (accuracy) are explained. The present work contains empirical examples of the different important indices on various samples and mainly focuses on psychometric properties of self-reported objective tests, including personality and tests reflecting problem detection and symptom severity.

3.1.1. Reliability in psychological testing

Reliability is the overall consistency of a psychological measure. The traditional concept of reliability is concerned with the repeatability of measurement and the level of consistency over a period of time and among different people. It is possible for a test to be highly reliable under one condition and unreliable under another (Gilbody et al., 2006). The background of reliability characterized by different psychometric indices:

1. Internal consistency indicates that the items in a measure are related to each other; in other words it suggests the level of intercorrelations among test items (Rózsa, 2009). This type of reliability focuses on the reproducibility of measurement across different items within a test. One of the most widely used indicators for this is the Cronbach's α coefficient (Jones and Thissen, 2007) (optimally between 0.65 and 0.95; a higher value indicates better internal consistency) (Rózsa, 2009). For the further estimation of internal consistency the Guttman split-half coefficient can be applied too.

2. Test-retest reliability is established by administering the same measure to a group of people on two occasions, separated by a designated period of time. In the event of perfect test-retest

reliability the correlation coefficient would be 1.0, indicating that the participants performed exactly the same on both occasions. There are several influential factors (e.g. fluctuations in mood) that could change the performance of a participant on the second occasion, and the correlation coefficient is therefore always lower than 1 (Gilbody et al., 2006). Assessment of the repeatability (test-retest reliability) of a psychometric test can be revealed by the intra-class correlation coefficient (ICC) (Anastasia, 1990), which is optimal at around 0.7, e.g. the Hungarian version of the Edinburgh Postnatal Depression Scale (EPDS) on an antepartum sample (Töreki et al., 2013); a value higher than 0.7 indicates an excellent intraclass correlation.

3. Interrater reliability: In the case of measures which cannot be repeated in time, the reliability can be assessed by comparing the ratings of two or more independent examiners to verify the extent to which they agree in their ratings/evaluations. An example of this is a diagnostic interview which is frequently used in clinical settings. In this case, a person's mental condition has to be examined at a particular time, which naturally changes with time. (Gilbody et al., 2006).

3.1.2. Validity in psychological testing

The validity of an assessment is the degree to which it measures the idea or construct it is supposed to measure.

1. Content validity: There are no empirical methods of assessing content validity. The major question is "does it measure what it purports to measure?" The content validity of instruments might be improved with the specification of theories about what one is trying to measure. Through *face validity,* it can be determined whether the researcher team agrees that the measure looks as if it is measuring what it is supposed to measure (Gilbody et al., 2006).

2. Criterion validity: Criterion validity shows how well one test result (e.g. a screening test) predicts an outcome based on information from another source (e.g. a diagnostic interview) (Töreki et al., 2013). Criterion validity is usually presented by receiver operating characteristic analysis (ROC) in terms of the specificity and the sensitivity of the test. Sensitivities and specificities are fundamental characteristics of a test. The sensitivity of the test is the proportion of positive cases that are correctly identified, while the specificity is the proportion of negative cases that are correctly identified. These criterion validity indices

change with the cut-off score. If a high cut-off score is chosen, most of those without a disorder will score below (high specificity), but many cases will also score below this level and will be missed (low sensitivity). On the other hand, with a lower cut-off score, more cases will be taken on (high sensitivity), but as a result a substantial proportion of people without the disorder will be incorrectly identified (lower specificity) (Gilbody et al., 2006).

3. Construct validity: The construct validity of a test is intimately connected with the theory that underpins the test. By means of a classic psychometric technique, construct validity can be determined by establishing convergent and divergent validity (Rózsa, 2009). Convergent validity is established when test measures that are predicted to be associated (because they measure the same thing) are found to be correlated. Divergent validity is established when the measures successfully discriminate between other measures of unrelated constructs. We expect high correlation coefficients between psychometric tests measuring the same constructs (divergent validity) and the lack of correlation between scores of tests measuring independent psychological constructs (Rózsa, 2009, Gilbody et al., 2006).

3.2. Assessment of the course of AD with psychometric tests: self-reported measures and neurocognitive assessment

AD is an enduring disorder with a devastating impact on the life of both patients and families. About 140 million people worldwide suffer from alcohol-related disorders. The harmful use of alcohol is one of the world's leading health risks. It is a causal factor in a number of major diseases and injuries resulting in 2.5 million deaths each year worldwide (WHO, Global status report on alcohol and health, 2011). Defined by "a persistent desire or unsuccessful efforts to cut down or control substance use", alcoholism is a complex phenomenon clinically, with a great deal of heterogeneity within the diagnostic group. The age at onset seems to be an important variable in the creation of relatively similar subgroups of patients diagnosed with AD both in the case of personality (Babor et al., 1992, Cloninger et al., 1981) and in the case of neurocognitive assessment (Bjork et al., 2004). Furthermore, patients with substance abuse mostly use and/or abuse more than one substance concurrently, although there is typically a clear drug of choice. This creates a great challenge in relation to neuropsychological and personality findings relating to users of a certain drug; the resulting problematic variables

might be, for instance, the definition of substance abuse groups, the level of polysubstance involvement, the degree of substance dependence severity, comorbid psychopathology and the measurement of personality and cognition (Fernández-Serrano et al., 2010, Conway et al., 2003). It is challenging to control these factors, but studies point in the same direction in the case of a current AD: maladaptive personality features (e.g. Sher and Trull, 1994, Basiaux et al., 2001) and neurocognitive/executive deficits (Fernández-Serrano et al., 2010) are major correlates.

In the assessment of AD and related problems, well-validated psychometric tests are essential (Rózsa, 2009). The direct severity indicators evaluate the quantity and frequency of use, the withdrawal phenomena and the negative consequences of drinking. Through indirect indicators of dependence severity, the addiction potential can be revealed through the general lifestyle characteristics and personality traits often associated with substance abuse. In the different phases of the development of the disorder, different tests can be informative. In this section, information is provided about the most often assessed alcohol consumption-related (psychological) variables and measures, if accessible with Hungarian reference. Of course, the presented measurements are merely examples, as there are ample tests for each phenomenon. The introduced assessments are selected according to the frequency with which they are applied, based on a literature review. For the assessment of factors predisposing to AD, relevant personality traits are measured; for the screening of individuals at higher risk of subsequent alcohol-related problems, the level of sensation-seeking among others is relevant (Rózsa, 2009). Screening tests can be used for the detection of problematic user individuals or to screen out individuals with alcohol dependence (ADPs) (Rózsa, 2009) e.g. CAGE (Gerevich et al., 2006, Ewing 1984,) and the Michigan Alcoholism Screening Test (Selzer, 1971). The Alcohol Use Disorders Identification Test (AUDIT) total score facilitates the recognition of alcohol problems and represents a direct severity indicator too (Saunders et al., 1993). AUDIT has proven to have excellent psychometric properties on a Hungarian sample (Rózsa et al., 2003) (further reliability and validity indices are presented in sections 6.1 and 6.2). It is emphasized that self-administered quantity and frequency-assessing methods are better than laboratory tests for the identification of AD (Aertgeerts et al. 2002).

Subsequent to the detection of the alcohol-related problems for the appropriate treatment plan, the severity of the clinical symptoms must be determined. A self-rating direct severity

indicator, the Severity of Alcohol Dependence Questionnaire (SADQ), is used to measure mainly the psycho-biological withdrawal phenomena (Stockwell et al., 1994, Meehan et al., 1985, Stockwell et al., 1979) (reliability and validity indices are presented in sections 6.1 and 6.2). To reveal the severity of alcohol consumption-related variables, the Hungarian version of the Addiction Severity Index (ASI) (Gerevich et al., 2004, Rácz et al., 2002), and to diagnose AD the criteria of the Structured Clinical Interview for DSM-IV Axis Disorders (SCID, First és mtsai., 1997ab) can be applied. These inventories are applied for clinical and research purposes in Hungarian general and clinical populations (Gerevich et al., 2006, Perczel-Forintos et al., 2007, Rózsa, 2009, Butcher et al., 2001/2009).

AD is frequently comorbid with other mental disturbances. In the alcohol detoxification phase or shortly after, and also among those who have relapsed, anxiodepressive symptoms are pronounced (Araujo et al., 1996; Brown et al., 1991). For the assessment of these symptoms, the Beck Depression Inventory (BDI) (Beck, 1961) and the State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1983) can be options.

Maladaptive personality traits are connected with the developmental, clinical and treatment aspects of AD. In AD the major focus is on the assessment of impulse control-related personality traits (for a review, see Verdejo-García et al., 2008), facets of impulsivity (e.g. the Barratt Impulsivity Scale-11) (Stanford et al., 2009, Paksi et al., 2009), sensation-seeking (Hittner and Swickert, 2006) and dimensions of aggression (e.g. the Buss-Perry Aggression Questionnaire) (Gerevich et al., 2007, Bácskai et al., 2011) are usually measured in the field of alcohol-related problems. The reduction of these impulse control-related variables could additionally serve as a treatment aim. For revealing the comprehensive personality characteristics associated with AD, most researchers operationalize the "Big Five" Personality Model (NEO-Personality Inventory) (Costa and McCrae 1995; Lackner et al., 2013), the Minnesota Multiphasic Personality Inventory clinical personality profile (MMPI) (Butcher et al., 2001/2009) and temperament and character factors (Temperament and Character Inventory- (TCI)) (Cloninger et al., 1993, 1994). It should be emphasized that the MMPI also contains indirect addiction severity indicators: well-validated scales for the detection of addiction, the MacAndrew Alcoholism Scale - Revised (MAC-R), the Addiction Potential Scale (APS) and the additional Addiction Admission Scale (AAS) (Butcher et al., 2001/2009) (validity indices are presented in section 6.2).

In the field of neuropsychology and addiction, the following cognitive domains are extensively assessed via neuropsychological instruments: memory, attention, executive function, psychomotor functioning, spatial processing, processing speed and emotion processing (Fernandez-Serrano et al., 2010). In AD among the executive functions, the decision-making mechanisms measured by the Iowa Gambling Task (IGT) (Bechara et al., 1994) seem to play a central role. There are at least two reasons for this: decision-making (DM) deficits are the core features of addictions, and even after long-term alcohol abstinence, DM deficits are still present (Fein et al., 2004). In the field of neuropsychological assessment, estimation of the IQ is vital: among ADPs, the Wechsler Adult Intelligence Scale is widely used in clinical settings (Bowde et al., 2001).

Via these measures, subgroups of patients and the different phases of AD can be characterized more precisely. These psychometric tests promote a deeper understanding of AD and the planning and evaluation of the efficacy of therapeutic interventions.

3.2.1. Personality and AD

The concept of an ''addictive personality'' has been disapproved (e.g. Kerr, 1996), though research evidence has revealed individual differences in several personality traits that can be reliably associated with substance use disorders, including AD. Further, patients with different substance use disorders can be distinguished through their personality profiles: ADPs have been characterized as less impulsive than cocaine or heroin abusers (Donovan et al., 1998, McCormick et al., 1998). It can be concluded that personality plays a crucial role in our current understanding of the developmental, clinical and therapeutic aspects of alcohol AD (George et al., 2010, Arnau et al., 2008, Basiaux et al., 2001).

Impulse control-related personality traits are strongly connected with substance use disorders (Verdejo-García et al., 2008). As a result of myopia for the future, ADPs ignore the negative long-term consequences of their drinking. They continue drinking despite the fact that or even because concurrent depressive and anxiety symptoms occur. It is noteworthy that this phenomenon forms part of the diagnostic criteria of AD: "alcohol use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by alcohol" (DSM-IV). Besides the fact that APs patients are characterized by higher impulsivity measures, it also appears to be a trait connected with

the developmental aspects of alcohol-related disorders (Verdejo-García et al., 2008). In addition to this, impulse control-related traits significantly influence the recovery by predicting relapse (Meszaros et al., 1999) and contribute to the ability to achieve and maintain prolonged abstinence (Fein et al., 2010a).

When AD is viewed in the light of its true developmental, clinical and therapeutic complexity, aspects of depression and anxiety symptoms similarly play an important role and have to be taken into account (Baker et al. 2012, Grant et al., 2004, Schuckit, 2009, Smith and Book, 2008). While substance use may induce symptoms of anxiety and depression (Smith and Book, 2008), psychiatric comorbidities can also lead to alcohol consumption/dependence as a means of self-medication.

There is good evidence for the idea that specific personality dimensions (e.g. sensation-seeking) serve as vulnerability factors to alcohol abuse (Zuckerman, 1994, Hittner and Swickert, 2006). On the other hand, lower levels of sensation-seeking are linked to the ability of maintaining prolonged abstinence (Fein et al., 2010b). It is concluded that, in the evaluation of AD, the starting point can be a specific personality factor, but a comprehensive personality model could also be beneficial for the assessment of AD.

Cloninger's comprehensive biosocial model of personality is based on 4 temperament factors [NS, harm avoidance (HA), reward dependence (RD) and persistence (P)] and 3 character dimensions [SD, cooperativeness (C) and self-transcendence (ST)]. Temperament factors are moderately inherited and relatively stable throughout life. NS is defined as a tendency to respond actively to novel stimuli and represents an impulse control related variable. HA is a hereditary tendency to inhibit or interrupt behaviour in order to avoid punishment and non-reward. RD involves the maintenance or continuation of behaviour previously associated with reinforcement. P is a tendency to the perseverance of behaviour, despite frustration and fatigue. Character dimensions develop during life through social experience and are influenced by learning. SD expresses an individual's competence regarding autonomy, reliability and maturity. C is related to individual differences in the acceptance of other people. ST refers to spiritual maturity, transpersonal identification and self-forgetfulness (Cloninger et al., 1993, 1994). The Temperament and Character Inventory (TCI) and its revised version (TCI-R) were developed to measure these personality dimensions (Cloninger et al., 1994, Cloninger, 1999).

This comprehensive psychobiological model of Cloninger has been used to understand the connections of personality to the stages of drinking carrier (Basiaux et al., 2001, Arnau et al., 2008, George et al., 2010). In adolescence, NS enhances the risk of alcohol use, and subsequent problematic drinking (George et al., 2010). In clinical settings, the differences between ADPs and a control group were recently investigated. These studies demonstrated that the ADPs differed from the control subjects in specific temperament and character factors. ADPs are characterized by higher levels of NS and HA (Le Bon et al., 2004), but this dimension is particularly pronounced among ADPs with late onset (Cloninger et al., 1988). SD is lower in AD (Basiaux et al., 2001, Le Bon et al., 2004), indicating an elevated probability of personality disorders (Svrakic et al., 2002). In AD, temperament and character factors modify the responses to therapeutic processes, and influence the treatment outcome. NS and HA have been shown to predict relapse (Meszaros et al., 1999), and better therapeutic evolution was predicted by higher P, SD and C factor scores (Arnau et al., 2008). Moreover, some research evidence pinpoints the associations between clinical symptoms and personality domains. In alcohol misuse, the problem drinking patterns measured by CAGE (Ewing, 1984) correlated positively with subscales of NS (NS1, explorative excitability), RD (RD3, attachment) and ST (ST1, self-forgetful), and negatively with a subscale of HA (HA3, shyness with strangers) (Kitamura et al., 1999). In another study, the MMPI-2 (Butcher et al., 1989) based substance abuse severity scales, the APS (Weed et al., 1992) and the MAC-R (MacAndrew, 1965, Butcher et al., 1989) were assessed in relation to temperament and character factors. Except for P, intercorrelations were found between the severity indicators of substance abuse and the TCI factors (Egger et al., 2007).

The course and the severity of substance-related problems can be evaluated in the framework of the biosocial model, but little is known about the relation to long-term abstinence. Moreover, only sparse information is available about the identification of the most powerful personality contributor to AD, and there is a lack of systematic analyses of different severity indicators of AD in connection with personality factors.

3.2.2. Neurocognitive functioning in AD

The use of psychoactive substances is connected with different neuropsychological deficits related to emotion, memory and executive functions. These deficits affect the core

characteristics of addiction: "the tendency to continue drug use despite its increasingly negative consequences" (Fernández-Serrano et al., 2010).

The determination of neuropsychological deficits in ADPs is crucial, since these deficits affect treatment planning and outcome. For instance, deficits in learning ability cause difficulties in the understanding of the information relating to the treatment and as a result the patient might be labelled erroneously as "unmotivated" (Fein et al., 1990). Neurocognitive disturbances can be detected in the course of AD; prior to the development of the disorder and also in the clinical state and in certain cognitive domains after many years of alcohol abstinence. Dysfunctions in neuropsychological domains (e.g., inhibition or decision-making) have been proposed to precede initial drug use and could predispose individuals to evolve substance use disorders (SUDs) (Verdejo-García et al., 2008).

During short-term alcohol abstinence (within 30 days), significant alterations were revealed in memory and learning, abstraction, problem-solving, cognitive flexibility, attention and perceptual motor speed, and different domains of impulsivity: response inhibition, preference for immediate reward, delay–discounting and risk-taking (Schottenbauer et al., 2007, Bjork et al. 2004, Ratti et al., 2002). Early-onset ADPs had a poorer performance on response inhibition, but performed similarly on delay-discounting and risk-taking measures (Bjork et al. 2004). Fein and colleagues revealed through a comprehensive neuropsychological assessment that ADPs after long-term abstinence performed similarly to non-alcohol users in all of the following domains: cognitive flexibility, attention, auditory working memory, immediate and delayed episodic memory, psychomotor function, reaction time, spatial processing and verbal skills (average 6.7 years, except for the spatial processing domain) (Fein et al. 2006). Neurocognitive deficits revealed by traditional neuropsychological measures in AD (Goldstein et al., 2004) were typically found to improve with the duration of abstinence (Fernández-Serrano et al., 2010, Fein and McGillivray, 2007).

However, impaired DM, a key determinant of addictive behaviour (Verdejo-García and Bechara, 2009), appears to constitute an important exception. A general finding in substance use disorders is that the patients have a preference for immediate reward (or punishment) (i.e. prompt effects of alcohol intake) without respect to the long-term outcome (i.e. health and social consequences). With the Iowa Gambling task, which models real-life decisions, patients with lesions of the ventromedial PFC were found to opt for the disadvantageous

decisions (Bechara et al., 2000), similarly to patients with SUDs. These DM skills remain inadequate even after many years of sobriety, as revealed by an overlapping DM pattern in active alcoholism and long-term abstinence in a gambling task (Fein et al., 2004). This is described as classic 'myopia for the future', manifested in the lack of an advantageous long-term strategy, strongly influenced by immediate reward preference and disregarding future consequences. Furthermore, reinforcement learning and DM deficits are strong predictors of poorer treatment outcomes in ADPs (De Wilde et al., 2013). A DM deficit can be detected even among adolescents with binge-drinking behaviour (Johnson et al., 2008) and it therefore seems that the adequacy of DM strategies are trait-like characteristics of AD, accompanying the whole course of AD.

In this work, the focus is on the assessment of the adequacy of DM in AD and after long-term abstinence among patients with intact neurocognitive functioning indicated by the IQ score.

3.2.3. Treatment of AD: spirituality and 12 steps in focus

Crucial pathways identified in the development of alcohol-related disorders are considered important targets for prevention and treatment interventions. A core feature of AD is the extreme difficulty in maintaining abstinence, resulting in a high relapse rate. The risk of relapse remains a continuous threat even after many years of abstinence (Dawson et al., 2007), while success in refraining from alcohol consumption is influenced by various factors (Dahlgren et al., 2011, Pinto et al., 2008). There is a great deal of heterogeneity within the diagnostic group of AD and there is no treatment approach that is suitable for everyone. In addition, the greatest challenge in the treatment of AD is most probably the long-term maintenance of abstinence (Mann and Hermann, 2010). Several psychosocial treatment modalities qualify the recommendation with "substantial clinical confidence" for the reduction of AD symptoms, the incidence and severity of relapse, and for the enhancement of psychological and social functioning. Great emphasis is placed on motivational enhancement therapy, cognitive-behavioural therapies, marital and family therapies, 12-step facilitation and on Alcoholics Anonymous (AA) self-help group (APA Practice Guidelines, 2006). Among these, the most widely used approach in AD treatment and relapse prevention is known as the 12–step-based intervention. Twelve-step groups (e.g. AA) in a mutual help programme are estimated to have more than 2.000.000 members in about 150 countries worldwide

(Alcoholics Anonymous World Services, Inc., 2006). The only requirement for membership is the expressed desire to stop drinking, with the primary purpose of staying sober and supporting other alcoholics in the process of achieving sobriety. Converging results from follow-up studies prove its efficacy on the improvement of alcohol consumption-related variables (Pagano et al., 2013, Kelly et al., 2011, Gossop et al., 2008), allowing longer abstinence maintenance (Majer et al., 2013). These beneficial changes might be related to the mobilization of adaptive social network changes (Kelly et al., 2011). The 12-step method significantly reduces both depressive symptom severity (Galanter et al., 2012) and measures of impulsiveness, leading to a better legal and psychosocial status and judgement (Blonigen et al., 2013, 2011). The concept largely relies on dimensions of spirituality and is essentially based on the "spiritual experience" and "spiritual awakening" (AA, 1939, 2001), mediated by the arising spiritual orientation (Kelly et al., 2011).

Spirituality is defined as people's attitude towards life itself, involving their level of acceptance of unchangeable situations and their open-mindedness for others and their environment (Frankl, 1963, 1969, Hill and Pargament, 2003). However it is not equal to religiosity, which by definition includes the institutionalized forms and practices of God-centered beliefs (Weisman et al., 2010). The relevant literature considers transcendence as a concept equivalent to spirituality (Arévalo et al., 2008, Cloninger, 2004). The different treatment approaches to AD also have to deal with the anxiodepressive symptoms. In the detoxification phase or shortly after, and also among those who have relapsed, these symptoms are pronounced (Araujo et al., 1996, Brown et al., 1991). However, with the length of abstinence, state anxiety typically decreases (Brown et al., 1991). There is also a growing body of evidence indicating the favourable impact of spiritual orientation on relapse prevention and recovery in the context of AA (Galanter et al., 2012, Kelly et al., 2011, Magura et al., 2013, Project MATCH Research Group, 1997, Project MATCH Research Group, 1998). In the framework of AA, the experience of spiritual awakening might be associated with a lower level of depressive symptoms (Blonigen et al., 2011), and the 12-step method significantly reduces measures of impulsiveness, leading to a better legal and psychosocial status and judgement (Blonigen et al., 2011, Blonigen et al., 2013). Because of its central role in the treatment, this work aims to understand the further role of spirituality in

alcohol recovery by operationalizing spirituality in the context of Cloninger's biosocial model of personality.

3.2.4. Complex approach for the assessment of AD

The NICE guideline for the treatment of AD emphasizes many different etiological factors: heritability, psychological-personality factors, psychiatric comorbidity, stress, adverse life events and cultural factors (NICE, 2011). This leads to the importance of interdisciplinarity in AD, which must be emphasized in the treatment too. Moreover, there is a great deal of heterogeneity within the diagnostic category of AD. As demonstrated already, the course of the disorder is affected by the personality and neuropsychological characteristics of the individual. However it should also be emphasized that these patients are also heterogeneous in terms of biological characteristics as well (Mann and Hermann, 2010). On the above basis, it is crucial to assess alcoholism as a complex "biopsychosocial disorder". The connection between the psychological constructs and biological background can be indicated by the temperament dimensions of the Cloninger TCI (Table 1) (Cloninger, 1999, Cloninger et al., 1994), which is widely used in the field of addiction. Table 1 summarizes the assumed neurotransmitters in the background of temperament factors and the relevant stimuli for the activation of the system and the behavioural response (for more information, see Cloninger, 1994). The P temperament factor is less investigated (Rózsa et al., 2004), and is therefore not included in the summary.

Table 1. The relationships between neurotransmitters, temperament dimensions and the stimulus-response characteristics

Temperament dimension	Major neuromodulator	Relevant stimulus	Behavioural response
Activation of behaviour NS	Dopamine	Novelty	Exploration
		Release from monotony	Active avoidance
Inhibition of behaviour HA	Serotonin	The conditioned stimulus of punishment and frustration	Passive avoidance
Maintenance of behaviour RD	Noradrenaline	The conditioned stimulus of relief	Resistance against extinction

The NICE guideline recommends a complex, comprehensive assessment for all adults (score more than 15 on the AUDIT) referred to specialized alcohol services. NICE also emphasizes the application of validated clinical tools, clinical interviews, the use of SADQ, and the assessment of psychological problems, including neurocognitive assessments (NICE 2011).

The complexity of the disorder is reflected in the scientific literature and this is also true at the level of individualized treatment, which is also reflected in the NICE guideline.

This work therefore involves different psychometric tests with a manifold empirical and theoretical background and self-reported and neurocognitive tests for a better understanding of the course of AD.

4. Aims

Carefully selected psychological tests are essential for the evaluation of complex disorders such as AD. In this work, basic psychometric indices are first assessed on distinct samples, involving tests with different theoretical backgrounds. On the other hand the focus will be placed on the assessment of AD with psychometric tests; personality and neurocognitive characteristics are presented in the context of the course of AD.

AIM1: A psychometric measure is reliable if it produces similar results consistently in different samples and over a period of time. The reliability indices of psychometric tests can vary as a result of the differences in theoretical backgrounds. Some personality tests are mainly designed for research purposes (e.g. short versions of the sensation-seeking scale (SSS); see Stephenson et al., 2003, Hoyle et al., 2002), while other clinical tests can have a direct effect on the treatment of the individual (e.g. AUDIT see: Babor et al., 2001). In this study, reliability analysis was carried out for psychometric tests designed for different purposes (mainly for research vs. clinical practice). Internal reliability and item-total correlations of the short form of SSS were therefore systematically analyzed on different samples: a Hungarian representative sample and a mixed clinical sample in order to evaluate the robustness of the internal consistency. It was assumed that the reliability indices are dependent on the sample characteristics and the number of items. The reliability indices should be excellent in the case of instruments which are involved in clinical practice and directly affect the treatment of the patient (AUDIT and EPDS). Internal consistency (Cronbach α) was therefore systematically assessed (AUDIT and EPDS) and the reliability over a period of time by test-retest reliability (EPDS). It was hypothesized that these clinical tests both have a superior Cronbach α compared with a short personality trait measure (the short form of SSS) used in epidemiological studies, mainly for research purposes.

Despite the fact that the NICE guideline recommends SADQ as a measure of the severity of AD, there is no Hungarian data as concerns its psychometric properties. Therefore, another aim is to provide certain psychometric data about this direct severity measure on a Hungarian clinical sample (STUDY1).

AIM2: The validity of widely used addiction-related self-reported direct and indirect severity measures is evaluated. Based on the assessment of validity, the following question is raised relating to the psychometric tests: "Does it measure what it purports to measure?". The question can be answered by testing convergent validity, using intercorrelations between self-reported "quantity and frequency" direct severity indicators. According to earlier findings AUDIT has excellent psychometric properties on a Hungarian sample (Rózsa et al., 2003); this valid measurement was correlated with SADQ to verify the validity of this measure too. It is hypothesized that the SADQ total score significantly correlates with the AUDIT total score. In the case of MMPI-2 based substance abuse scales (MAC, APS and AAS), it is intended to measure the criterion validity via ROC analysis. This method gives information about the sensitivity and specificity of these indirect severity measures (STUDY2).

AIM3: Another goal of the present examination was to reveal the temperament and character factors related to AD and symptom severity. The TCI-R profiles of ADPs were compared with those of normal controls matched by age, gender and duration of education. Numerous studies have compared ADPs with controls on the basis of temperament and character factors; however, no information is available on the strength of these differences. In this study, therefore, TCI-R profiles of ADPs were compared with those of random Hungarian normative controls matched for age, gender and duration of education; furthermore, the Cohen d was calculated in order to find the most powerful TCI-R factor related to AD. It was hypothesized that higher levels of NS and HA, and a lower level of SD are connected to alcohol dependence. Another aim is to assess direct (AUDIT and ASDQ) and indirect (MAC-R and APS) addiction severity indicators reflecting the complexity of alcohol addiction to characterize patients with AD. Application of a complex set of standardized severity indicators connected to temperament and character can extend our knowledge about patients with more severe forms of addiction. The direct addiction severity indicators were utilized to evaluate the quantity and frequency of alcohol use, the withdrawal phenomena and the adverse consequences of drinking. Likewise, through indirect indicators of AD severity, the

addiction potential was assessed via the general lifestyle characteristics and personality traits often associated with substance abuse. The main question was whether the severity of symptoms of AD could be explained by temperament and character factors. In recent research, NS was identified as an elemental factor in addictive behaviour, and it was therefore assumed that this dimension is the most powerful determinant of the symptom severity of AD (STUDY3).

AIM4: Previous studies have demonstrated a persistent DM deficit in AD even after long-term abstinence. It is assumed that patients are able to maintain sustained abstinence in spite of the DM deficit. Therefore, the aim was to reveal specific personality features of the biosocial model, presumed to compensate for ineffective DM skills. In the effort to assess the long-term alcohol abstinence ability, we took an integrative approach, combining neurocognitive and personality measures. DM skills, temperament and character domains were assessed in relation to abstinence length in two groups of non-medicated ADPs with intact general cognitive functioning. The short-term abstinence (STA) group recently started an inpatient alcohol cessation treatment programme, while the long-term abstinence (LTA) group included patients who had not consumed alcohol for several years. This allowed us to examine specific contributors influencing abstinence length and the ability to maintain it in order to detect potential biological and psychosocial correlates of **abstinence sustenance** in alcohol dependence. In the context of previous findings of inadequate DM profiles in alcoholism, we expected patients in different stages of recovery to show a similar impaired performance in the gambling task, and on the other hand a more optimal personality profile for patients with LTA (STUDY4).

AIM5: An additional goal of the present work is to assess the further role of spirituality in alcohol recovery. For this reason, in a cross-sectional study spiritual orientation is represented by means of ST, a character factor of the Cloninger biosocial model of personality. In addition to transcendental orientation, anxiodepressive symptoms were also monitored. We tested three different alcohol treatment settings, which differently involve elements of spirituality, in order to reveal the possible mediator effects on the levels of depressive and anxiety symptoms. Participants were assigned to groups on the basis of the current stage of their treatment, ranging from the detoxification phase through long-term membership in 12-

step-based rehabilitation, i.e. at least 3 year AA attendance. This allowed us to focus on the level of "spiritual awakening" among different treatment settings.

We can conclude from earlier research that, during the recovery process, depressive and anxiety symptoms are reduced. However, no study is available that examines spirituality in the context of different treatment settings and the reduction of anxiodepressive symptoms. The role of spirituality was assessed in the treatment; spirituality was therefore not studied as an isolated trait. The question remains open as to whether spirituality in fact has a mediating role in the reduction of anxiety and depressive symptoms. In order to examine the possible mediating role of spirituality in the reduction of these symptoms during recovery from AD, these symptoms were assessed and spirituality in three different treatment settings that involve the concept of spirituality at different levels in the treatment (STUDY5).

5. Methods

5.1. STUDY1: Reliability assessment of psychometric tests

5.1.1. Participants

The assessment of reliability indices was carried out on 4 different samples. All of the study protocols were approved by the local Research Ethics Committee. Informed consent was obtained.

Sample A The psychometric assessment of the SSS was performed on a Hungarian representative sample. The data collection was performed in 2003 (ADE-2003). The total sample consisted of 2557 people (1280 female, mean age 36.00, S.D.: 10.90, age range 18-54) (for more details, see Paksi, 2007).

Sample B For further psychometric evaluation of the SSS a special population sample was involved. The total sample (N=314, 115 female, mean age: 24.30, S.D.: 3.7, age range 18-35) contained 4 subgroups: 3 drug-user subgroups (opiate, N=91; stimulant, N=42, cannabis, N=92) and a control subgroup (N=89) (for more details, see Demetrovics, 2007).

Sample C For the assessment of EPDS, a screening psychometric test for perinatal depression, 266 mothers were evaluated (mean age: 30.5, S.D.: 4.57; age range 18–42). The women participated in the study between the sixth and eighth weeks after delivery. The participants

were invited to complete the EPDS once more, 3 days after the first screening, and 157 (59%) did so.

Sample D To reveal the reliability indices of alcohol-related psychometric tests 81 ADPs (28 female, mean age: 43.93 S.D.: 9.22, age range 25-61) were recruited from inpatient centers at the University of Szeged Addiction Ward and the Hospital of Szigetvár Addiction Ward (for more details, see the data collection procedure in section 5.3.1).

5.1.2. Measures

The reliability assessment was carried out for the following measures.

SSS - short form (9 item) (Samples A and B)*:*

The 40-item SSS V reveals the general trait of sensation-seeking (Zuckerman, 1994). This measurement has outstanding reliability and validity indices (Roberti et al., 2003). Under many circumstances, however, its applicability is restricted due to its time-consuming nature. The original 40 items were reduced to 9 by Dr. Sándor Rózsa through selection of the psychometrically most appropriate 9 statement pairs. The psychometric characteristics of the short questionnaire, which is widely used in Hungarian epidemiological researches, were examined. By means of the reduced number of items, it is possible to assess the general trait of sensation-seeking in a more time-effective way (for more information about the short versions of SSS, see Hoyle et al., 2002, Stephenson et al., 2003).

EPDS (Sample C)

To detect postnatal depression, a 10-item self-report scale, known as the EPDS was created, each item rated on a 4-point scale. The EPDS has been translated into and validated in over 30 languages (Gibson et al., 2009).

The English version of the EPDS, a scale for measuring peripartum depressive symptoms, was translated into Hungarian and then translated back according to the criteria for cross-cultural equivalence in our previous study, and showed relatively good screening properties for antenatal depression. A higher score indicates a higher level of depressive symptoms (Töreki et al., 2013).

SADQ (Sample D)

The SADQ is a self-rating instrument used to measure mainly the psycho-biological withdrawal phenomena. SADQ is a direct severity indicator and covers the following aspects

of AD: physical withdrawal symptoms, affective withdrawal symptoms, relief drinking, frequency of alcohol consumption and the speed of onset of withdrawal symptoms. It contains 20 items, each rated on a 4-point scale. A higher score indicates a higher severity of dependence (Stockwell et al., 1994, Meehan et al., 1985, Stockwell et al., 1979).

AUDIT (Sample D)

The AUDIT developed by the World WHO, facilitates the recognition of a current AD and specific consequences of harmful drinking. The AUDIT, a direct severity indicator, consists of 10 questions concerning the current quantity and frequency of alcohol use (AUDIT-LC; items 1-3), AD symptoms (AUDIT-D; items 4-7), and adverse consequences of drinking (AUDIT-C; items 8-10) (Rózsa, 2009). A higher total score on the AUDIT (AUDIT-T) indicates a greater severity of alcohol problems and dependence, and a greater need for more intensive treatment. AUDIT has been validated worldwide, including a Hungarian sample, indicating excellent psychometric properties (Rózsa et al., 2003, Babor et al., 2001)

5.1.3. Data analysis

Statistical analysis was performed with the Statistical Package for Social Sciences (SPSS) software.

Samples A and B: On these samples, the aim was to create a shorter measure which assesses the general trait of sensation-seeking in a more time-effective way and also preserves good psychometric qualities. The reliability characteristics of the short questionnaire, containing 9 statement-pairs, were examined on two independent samples: a Hungarian representative sample and a special population sample. Reliability coefficients measured by Cronbach α were calculated for the 9-8-7-item versions of SSS in order to assess the internal consistency of the possible shorter instrument. The Cronbach α, item-total correlations and Cronbach α value without the item were also analyzed in both samples in order to reveal the robustness of the internal consistency of the instrument. Via this process, based on these reliability indices, the optimum numbers of items were determined.

Sample C: In the EPDS Cronbach α was calculated and the role of each item in the total Cronbach α was analyzed; additionally, the Guttman split-half coefficient was calculated. The repeatability (test-retest reliability) of the EPDS was assessed by using the intra-class

correlation coefficient (ICC). We expected that the ICC for the EPDS items would exceed 0.7 (Anastasia, 1990).

Sample D: The Cronbach *α*, item-total correlations and the Cronbach *α* value without the item were analysed in the case of the AUDIT. In order to verify the internal consistency of the SADQ, the Cronbach *α* and the Guttman split-half coefficient were also calculated.

5.2. STUDY2: Validity assessment of psychometric tests

5.2.1. Participants

The assessment of validity indices was carried out on 2 different samples. All of the study protocols were approved by the local Research Ethics Committee. Informed consent was obtained from all the subjects.

Sample D See section 5.1.1.

Sample E A total of 186 people participated in our study. Sixty-three (average age: 43.73 S.D.: 8.88, 21 female) patients who completed MMPI-2 were enrolled from the addictology wards of Hospital of Szigetvár and the University of Szeged Department of Psychiatry. The patients were diagnosed with AD according to the criteria of DSM-IV. One hundred and twenty three (average age: 42.78, and S.D.: 9.16, 42 female) people from the database created as a normative sample of the Hungarian population for the MMPI-2 were used as control group. The sample for the control group was matched to the patients by age, gender and educational level (Drótos et al., 2011)

5.2.2. Measures

The validity assessment was carried out for the following addiction measures.

SADQ (Sample D) (see section 5.1.2), *AUDIT (Sample D)* (see section 5.1.2)

MAC-R (Sample E)

The MMPI-2 based MAC-R consists of 49 true-false items that are not directly connected to alcohol use. The MAC-R, an indirect severity indicator assesses the addiction potential through general lifestyle characteristics and personality traits frequently connected with alcohol abuse (MacAndrew, 1965, Butcher et al., 2001/2009). Schwartz and Graham (1979) found 6 domains that are associated with the MAC score: cognitive impairment, social

maladjustment, interpersonal competence, risk-taking, extroversion and exhibition and moral indignation. A higher score on the MAC-R indicates a higher level of alcohol-related belligerence and aggression, together with problems with the authorities. Furthermore, an elevated MAC-R score is associated with drinking patterns and especially with a higher preference for social drinking (Svanum and Ehrmann, 1992).

APS (Sample E)

The MMPI-2 includes another indirect severity indicator, the APS; similarly to the MAC-R, it was designed to identify personality factors and lifestyle characteristics associated with substance use. It consists of 39 true-false items (Weed et al., 1992). The APS assesses the following personality dimensions: satisfaction/dissatisfaction, powerlessness/lack of self-efficacy, antisocial acting-out, surgency and risk-taking recklessness (Sawrie et al., 1996).

AAS (Sample E)

The MMPI-2 also includes the AAS, which detects the acknowledgment of alcohol-drug problems in the context of a general personality assessment through 13 true-false items (Svanum et al., 1994, Greene et al., 1992).

5.2.3. Data analysis

In order to verify the convergent validity of the SADQ, the correlation between the total scores of the SADQ and the AUDIT was measured on *sample D*. Pearson's correlation coefficient of around 0.5 indicates optimum convergent validity.

For the measure of criterion validity of MMPI-2-based substance abuse scales (MAC-R, APS and AAS) ROC analysis was carried out on *sample E*. All analyses were performed by using SPSS version 17.0, for *t*he demographic comparison of the patient and control groups by the Pearson chi-square, Mann-Whitney and Student t-tests for categorical and continuous variables respectively. To assess the diagnostic efficiency of the MAC-R, the APS and AAS scales of the MMPI-2 ROC curves (Fawcett, 2004) were obtained and the three instruments were combined by means of logistic regression. The optimal cutoff points were selected according to the highest Youden index (Perkins and Schisterman, 2006) and the sensitivity, specificity and accuracy percentages were calculated.

5.3. STUDY3: Personality and AD in the light of psychometric tests

5.3.1. Participants

Sample F A total of 247 subjects were involved in this evaluation. Eighty-one ADPs (mean age: 43.93; N=53 male) were recruited from inpatient centers at the University of Szeged Addiction Ward, and the Hospital of Szigetvár Addiction Ward (see *sample D*). One hundred and sixty-six control subjects (mean age: 43.23; N=105 male) from the normative Hungarian TCI-R database were matched to *sample D* by age, gender and level of education.

Two-step procedures were applied to enroll the ADPs. First, the exclusion criteria were assessed by a medical specialist in the field of psychiatry and addiction, based on the clinical use of ICD-10 (WHO 1993). Through this procedure, we excluded all patients with (1) a dependence on any psychoactive substance other than alcohol (with the exceptions of nicotine and caffeine), (2) acute alcohol consumption, (3) diseases of the central nervous system, (4) current or previous mood and schizophrenia spectrum disorders and (5) actual withdrawal syndrome. The Ethics Committee of the University of Szeged approved the study protocol and all participants signed an informed consent form prior to their participation.

5.3.2. Measures

TCI

All participants completed the TCI-R, which contains 240 questions. It offers quantitative measures of the Cloninger's biosocial model of personality. This personality model quantifies 4 temperament dimensions (NS, HA, RD and P) and 3 character dimensions (SD, C and ST). Two modifications were made in the TCI-R: (1) the participants had to respond on a 5-point Likert scale (1—definitely false; 2—mostly or probably false; 3—neither true nor false or about equally true or false; 4—mostly or probably true; 5—definitely true), and (2) the temperament factor P was more elaborated: this revised subscale contains 35 items and 4 subscales (Cloninger, 1999, Rózsa et al., 2004). Studies have shown that the TCI-R has excellent psychometric properties (e.g. Goncalves et al., 2010, Fossati et al., 2007).

*SADQ (*see section *5.1.2), AUDIT* (see section 5.1.2)*, MAC-R* (see section 5.2.2)*, APS* (see section 5.2.2)

5.3.3. Data analysis

Statistical analyses were performed with the SPSS for Windows version 15.0. To assess group differences between ADPs and controls in the case of categorical variables, the chi–squared test was carried out, and the t-test was applied for continuous variables. The Cohen d was calculated in order to reveal the most powerful differences between the TCI-R dimensions among the ADPs and the matched control group (Cohen, 1988). Partial correlation analyses were conducted in order to assess addiction severity indicators connected with temperament and character factors, independently of age and gender. These variables were selected as covariates because of their possible association with personality factors (Cloninger et al., 1994). To find the most powerful predictors for each addiction severity indicator, stepwise linear regression was applied. Four regression models were constructed, where the independent variables were gender and age, and the 7 temperament and character factors. The dependent variables in the models were: SADQ, AUDIT-T, MAC-R and APS. Differences of $p<0.05$ were regarded as significant.

5.4. STUDY4: Neurocognitive and personality determinants of long-term alcohol abstinence

5.4.1. Participants and procedure

Sample G The study group comprised 88 patients with a lifetime diagnosis of alcohol dependence based on the DSM-IV (American Psychiatric Association 2000: Diagnostic and Statistical Manual of Mental Disorders, Fourth, Text Revisioned, Washington DC. American Psychiatric Association). Patients were recruited from the inpatient and outpatient unit of the Hospital of Szigetvár, a unique and comprehensive healthcare provider for ADPs from all over Hungary. Participants were arranged in two groups based on the length of abstinence. The STA group (N=43) (average age: 45.47, S.D.: 9.28,17 female) comprised patients currently participating in the inpatient treatment programme at Hospital of Szigetvár and displayed an average abstinence period of 12 weeks. The LTA group (N=45) (average age: 51.51, S.D.: 7.58, 9 female) comprised participants characterized by abstinence longer than 3 years, at that time attending AA groups. As the neurocognitive assessment of DM was also included in the study, only participants with intact general cognitive functioning (IQ scores

above 90) were enrolled. The two groups were closely matched for gender, IQ and years of education. Written informed consent was obtained from all participants after approval of the study protocol by the local Ethics Committee. All patients were assessed for demographic and alcohol consumption-related variables (i.e. age at onset of regular alcohol consumption, duration of problematic drinking in years, and last time of drinking alcohol). All participants with significant neurological illness, significant head injury, a history of mood disorder independent of alcohol use, a history of schizophrenia spectrum disorder or a history of drug dependence were excluded. Patients reporting acute alcohol abuse were also excluded. Exclusion criteria were identified on the basis of the medical records and chart notes of the treating physician specialized in psychiatry and addictology. Accurate inclusion criteria were further verified in the interview phase. The absence of any major psychiatric disorder was certified with no exception for participants included in the study and the final analysis. Patients suffering from an affective disorder related to AD — major depression primarily — were not excluded. The patients were not taking any psychotropic medication at the time of participation. The two groups were closely matched for alcohol use-related variables indicating AD severity (i.e. the age at first alcohol consumption and the duration of regular alcohol consumption).

5.4.2. Measures

IGT

The computerized 'ABCD' version of the IGT was administered to assess the decision making ability and adequacy (Bechara et al., 1994, Bechara et al., 2000, Bechara et al., 2004). This is a widely used and methodologically established research allowing to the modeling of real-life like DM tendencies.

All participants received standard instructions (Bechara et al., 2000) and were told that the aim of the task was to win as much game money as possible. In this version of the IGT, 4 decks of cards are presented on the computer screen, labelled as A, B, C and D and differing in their monetary profile. Each deck contains 60 cards. Participants choose freely from the decks by clicking with the mouse on the back of the cards, one choice at a time. Each card choice results in a monetary win, but occasionally also in a certain monetary loss. This is accurately depicted on the screen with a green bar indicating the total amount of game money

acquired. The game ends after 100 selections have been made. Decks A and B are considered disadvantageous, associated with high immediate win but occasionally even higher penalties resulting in a net loss over time. Decks C and D are considered advantageous, associated with small immediate reward but even smaller long-term punishment resulting in a gradual accumulation of monetary profit. Participants are required to learn to make long term advantageous decisions based solely on the trial-by-trial feedback. Choices were subsequently analyzed over five blocks of 20 trials and over the total score after 100 selections. Selections were classified advantageous (for decks C and D) and disadvantageous (for decks A and B). Decision making capacity is the net difference between the total number of advantageous and disadvantageous choices (C+D)-(A+B), calculated for each 20 trial block.

ASI

The Hungarian version of ASI covers 7 potential problem areas usually connected to substance use disorders: medical, employment, alcohol, drug, legal, family/social and psychiatric (Rácz et al., 2002, Gerevich et al., 2004). In this study, ASI was used for the assessment of demographic and alcohol consumption-related variables (i.e. age at onset of regular alcohol consumption and duration of problematic drinking in years). This interview was complemented with a question indicating the length of abstinence (i.e. "When was the last time you drank alcohol?") (Rácz et al., 2002).

TCI-R (see section 5.3.2)

Wechsler Adult Intelligence Scale

For the assessment of general cognitive functioning, the Hungarian version of the Wechsler Adult Intelligence Scale was used (MAWI). This measure indicates IQ, the performance IQ (PQ) and the verbal IQ (VQ) (WAIS, Kun and Szegedi, 1997). In this study, these scores were calculated.

5.4.3. Data analysis

Statistical analysis was performed with the version 14th of the Statistical SPSS. The Kolmogorov-Smirnov probe was applied to assess the normal distribution of the variables. Group differences in sociodemographic and alcohol use-related variables were tested by using 2-tailed, independent-sample t-tests and Mann-Whitney probes for continuous variables, and chi-squared probes for categorical variables.

Group performances in the IGT and TCI-R were compared by using a multivariate analysis of covariance (MANCOVA) approach. Univariate analysis of variance (ANOVA) with linear trend analysis was performed for both groups to evaluate DM efficacy and the presence of a learning effect. Alcohol use indicators in relation to overall IGT performance were assessed by using partial correlation analyses.

All statistical analysis performed subsequently accounted for the statistically significant difference in mean age between the groups.

5.5. STUDY5: Recovery from AD: 12 steps and the role of spirituality

5.5.1. Participants and procedure

Sample H One hundred and sixty nine participants (mean age: 45.7; 116 male) were enrolled in the study, all meeting the DSM-IV diagnostic criteria for lifetime AD. In order to be able to assess the mediating role of spirituality in the reduction of anxiety and depressive symptoms, subjects were recruited from three different treatment settings. Based on the treatment protocols, these treatment settings involve spirituality at different levels. These were (1) detoxification (no spiritual component of the formal treatment; mainly pharmacotherapy), (2) long- term (12-step-based) therapeutic community treatment (lower spirituality; 1-4 steps studied extensively), and (3) at least 3 years of AA attendance after the long-term (12-step-based) therapeutic community treatment (high spirituality; 1-12 steps studied). Thirty-four of the 169 subjects were hospitalized for detoxification purposes (detoxification group; DTG) at the University of Szeged Department of Psychiatry, Alcohol Treatment Unit (N=34), while 89 were hospitalized in a long-term therapeutic community programme based on the 12-step approach and the Minnesota Model (MM) (therapeutic community group; TCG) at the Hospital of Szigetvár. A further 46 participants were regular (at least once a week) AA group attendees. The hospitalization at the alcohol treatment unit (DTG) had an average duration of 2 weeks. The standard AD therapy focuses primarily on the pharmacological handling of withdrawal symptoms. The MM-based inpatient therapeutic community programme involved a complex set of therapeutic programmes including individual and family psychotherapy, group meetings, lectures and counselling, as well as referral to medical and social services if needed. Prior to the inpatient admission, the patient had to visit 2 AA meetings. As the MM

programme includes family psychotherapy, a close relative is also involved in the treatment and functions as a contact person. Furthermore, the MM programme relies strongly on the 12-step and the first 4 steps are extensively studied. In the course of treatment, these steps are discussed in detail at the group meetings led by a recovering alcoholic trained in group therapy. The therapeutic programmes are held within the treatment framework, which typically lasts for a period of 6 months. Participants in the third group were attending a 12-step-based AA group after the MM therapeutic community programme without relapse for at least 3 years. These participants follow the general propositions of AA, which includes sponsorship (e.g. Witbrodt et al., 2012). Patients with a current psychoactive substance dependence, other than nicotine or caffeine, and those with acute alcohol consumption (an AT128 Digital Alcohol Tester was utilized in the AAG), neurological disorders, current or previous mood disorders independent of AD, current or previous schizophrenia spectrum disorders, or current acute withdrawal syndromes were excluded from the study. All interviews were conducted by two trained clinical psychologists. The Institution Review Board approved the study protocol and the informed consent form.

5.5.2. Measures

TCI-R: ST scale

The present study focuses on the ST character factor (Cloninger, 1999, Rózsa et al., 2004) measured by TCI–R. The AA core concept of spirituality significantly focuses on the relationship with and acceptance of some higher power (Arnold et. al., 2002, Carrico et al., 2007), while ST signifies behaviours and views that have both spiritual (the ability to live in the present, practicing acceptance and experiencing a sense of meaning) and psychological (the capability to relate to oneself and others) aspects (Reed, 2009). Due to these overlaps in the definitions, the transcendence personality trait was considered as an equivalent concept to spirituality (Arvealo et al., 2008, Cloninger, 2004), but the word transcendence is not a common part of the vocabulary of spiritually-oriented recovery communities.

ASI (see section 5.4.2), *AUDIT* (see section 5.1.2)

BDI

The BDI was administered to quantify the severity of current depressive symptoms. This clinical assessment tool consists of 21 items, with the total score ranging between 0 and 63. Higher BDI scores indicate more severe current depressive symptoms (Beck, 1961).

STAI

Anxiety symptoms were assessed with the STAI. This consists of 20 items regarding trait anxiety while 20 questions quantify state anxiety. Responses are given on a frequency scale ranging from 1 (almost never) to 4 (almost always) (Spielberger et al., 1983).

5.5.3. Data analysis

Basic statistical analysis was performed with SPSS for Windows (version 15.0). Group differences in sociodemographic and alcohol use-related variables were tested by using one-way ANOVA and Kruskal–Wallis analysis. Group performance on the TCI–R-ST, BDI, STAI–S and STAI–T were compared by using one-way univariate ANOVA with the LSD post-hoc test. We performed a path analysis with the MPLUS 7.0 software, and maximum likelihood estimation robust to the deviation from normal distribution (MLR) was used to estimate the model. One fully saturated model was proposed to estimate the mediation effect of spirituality between treatment types and outcome variables. The model is depicted in Figure 3 (see section 6.5). All variables were used as observed ones. The fully saturated model was estimated in order to provide a more conservative test of the expected indirect pathways. The exogenous variables were allowed to co-vary. The path model with the significant coefficients is presented in Figure 3 (see section 6.5). The direct and indirect effects are presented in Table 11 (see section 6.5.). Due to the fully saturated model the model, fit was not examined. In order to code the spiritual characteristic of the three treatment groups, we applied two dummy codes. The first code represented the treatment with a low degree of spiritual component, such as the Minnesota programme, and the other dummy coded the treatment with a high spiritual component, such as the 12-step approach group. The detoxification programme is regarded in the treatment with no spiritual component.

6. Results

6.1. STUDY1: Reliability assessment of psychometric tests

In order to create a shorter sensation-seeking measure which preserves good reliability indices, the internal consistency of the questionnaire, containing 9 statement-pairs, was first examined on two independent samples. In the case of 9 items the Cronbach α value is above 0.6 on the Hungarian representative sample (*sample A*) and above 0.55 on *sample B*. However, it was obvious that item 9 does not fit the whole scale based on the item-total correlation, which was lower than 0.15. In the case of the 8-item version of the SSS, the item-total correlations revealed that two items (7 and 8) had the lowest levels of match to the whole scale. The psychometric analysis was performed in three ways: (1) without item 7 (2) without item 8 and (3) without items 7 and 8. The most appropriate reliability indices were revealed by deleting item 7. The final version of the SSS contains 7 items (SSS-7-HU) (see Table 2).

Table 2. The psychometric properties of the SSS-7-HU on two samples (item-total correlations under 0.3 are underlined)

Items of SSS-7-HU	A sample		B sample	
	Corrected item-total correlation	Cronbach α value for SSS-7HU without the item	Corrected item-total correlation	Cronbach α value for SSS-7HU without the item
1.	0.379	0.620	<u>0.275</u>	0.510
2.	0.419	0.604	<u>0.218</u>	0.531
3.	<u>0.215</u>	0.656	0.342	0.482
4.	0.484	0.580	0.391	0.473
5.	0.323	0.633	0.329	0.487
6.	0.407	0.609	<u>0.236</u>	0.524
8.	0.335	0.630	<u>0.166</u>	0.555
Cronbach α (7 items)	0.656		0.548	

In the case of internationally used screening tests, the number of items is predefined. The AUDIT and EPDS are involved in clinical practice for screening purposes; the psychometric indices should therefore be excellent. These two widely used measures were analysed on the basis of the internal consistency. The reliability of the EPDS in terms of the Cronbach α coefficients showed good internal consistency (Cronbach α=0.75), and the Guttman split-half

coefficient verified the reliability of this measure as it was 0.788 (*sample C*). Furthermore, the reliability of the AUDIT also showed good internal consistency (Cronbach α=0.791, Guttman split-half coefficient: 0.813) (*Sample D)*. Table 3 lists the internal consistency indices in the case of the two screening measures: AUDIT and EPDS.

Table 3. reliability indices of AUDIT and EPDS

Items of AUDIT (Sample D)	Cronbach α value for EPDS without the item	Items of EPDS (sample C)	Cronbach α value for EPDS without the item
AUDIT_1	0.787	EPDS_1	0.725
AUDIT_2	0.766	EPDS_2	0.737
AUDIT_3	0.754	EPDS_3	0.723
AUDIT_4	0.753	EPDS_4	0.717
AUDIT_5	0.759	EPDS_5	0.730
AUDIT_6	0.785	EPDS_6	0.725
AUDIT_7	0.769	EPDS_7	0.738
AUDIT_8	0.762	EPDS_8	0.722
AUDIT_9	0.787	EPDS_9	0.723
AUDIT_10	0.799	EPDS_10	0.747

The SADQ specifically assesses the severity of AD and on a Hungarian clinical sample shows excellent reliability indices: Cronbach α=0.909, Guttman split-half coefficient: 0.822 (*sample D*). On *sample C,* it was possible to assess the test–retest reliability of the EPDS. From one assessment to the next, it was evaluated in a sample of 157 mothers. The interval between the two time points of screening was on average 3–5 days. From the EPDS scores at the first and second assessment sessions the ICC was 0.886 (p<0.001).

6.2. STUDY2: Validity assessment of psychometric tests

Besides the assessment of reliability validity indices are also presented in this work. In this section, the results of addiction-related psychometric tests are presented. It has already been demonstrated on a Hungarian national representative sample that the AUDIT is valid for

measuring alcohol-related problems (Rózsa et al., 2003). On *sample D,* convergent validity was tested by the correlation of the SADQ with an already validated test (AUDIT, see Rózsa et al., 2003). The Pearson correlation revealed a significant correlation between the SADQ and AUDIT (r=0.537, p<001), indicating that SADQ is also a valid measure for alcohol-related problems. The assessment of the criterion validity for the MAC-R, APS and AAS was carried out via ROC analysis on *sample E*. The patient group did not differ significantly from the normal controls in age (t=0.68; p=0.5), gender (X^2=0.01; p=0.91) or education (X^2=0.05; p=0.97). The AD group achieved significantly higher scores in all three addiction related measurements [(MAC-R; ADP: mean=25.84, SD=4.76; control: mean=21.81, SD=4.45; t=5.67; p<0.001); (APS; ADP: mean=26.46, SD=3.76; control: mean=22.34, SD=3.54; t=7.28; p<0.001); (AAS; ADP: mean=5.62, SD=2.68; control: mean=2.27, SD=2.17; U=1269; p<0.001)]. The main results of our study were the good diagnostic efficiency (high AUC values) of the APS and MAC-R scales, while the AAS had the largest area under the ROC curve (see Table 4 and Fig. 1). The optimum cut-off point found with the help of the Youden index was 2.5 for the AAS scale, which classified 55 ADPs correctly while generating 8 false-negatives and 43 false-positives. The cut-off point at 25.5 maximizes the sensitivity and specificity of the APS, scale through which 40 patients were correctly identified and 19 false-positives generated, while 23 people from the control group were classified incorrectly as ADPs. According to the chi-squared test, the APS and AAS scale classifications differed significantly (X^2=16.76; p<0.001) and the MAC-R scale classification differed from APS (X^2=36.28; p<0.001) and AAS (X^2=3.98; p=0.046). 21.5 points was the optimum cut-off point for the MAC-R scale, which means 54 true-positive results, 63 false-positives and 9 false-negatives. According to the results, all the dependency scales have good diagnostic sensitivity, though the combination of the three curves gives the best sensitivity and specificity values at the 0.66 cut-off point, with 55 correctly identified patients and only 8 false-negatives and 19 false-positives.

Table 4. Results of ROC analysis

	Cut-off	**Sensitivity**	**Specificity**				Lower	Upper
MAC-R	21.5	**85.2%**	**48.8%**	**0.729**	0.04	<0.001	0.653	0.805
AAS	2.5	**86.9%**	**65.3%**	**0.828**	0.03	<0.001	0.767	0.890
APS	25.5	**63.9%**	**84.3%**	**0.788**	0.04	<0.001	0.716	0.859
Log	0.66	**86.9%**	**85.1%**	**0.903**	0.02	<0.001	0.856	0.95
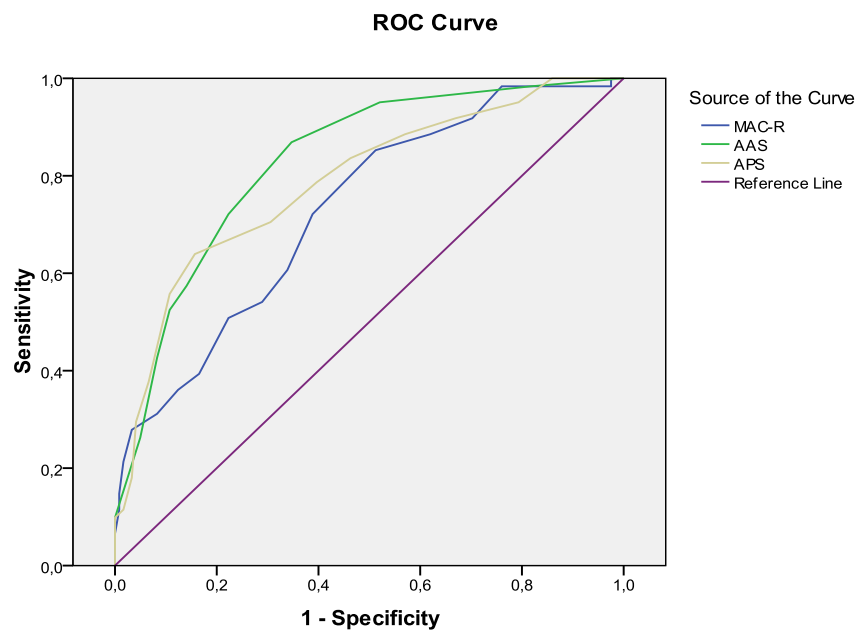
Figure 1. The diagnostic accuracy of MAC-R, AAS and APS

6.3. STUDY3: Personality and AD in the light of psychometric tests

There were no significant differences between the ADPs and the control groups in terms of age, level of education or gender.

Among the temperament factors, the ADPs displayed significantly higher levels of NS and HA and a lower level of P as compared with the normal controls. In the case of RD, no significant difference was found between the ADPs and the control group. As concerns the character factors, SD and C were significantly lower in the ADPs, while no significant

difference was found in ST. The magnitude of Cohen's d effect indicated that the character factor SD is the most powerful contributor to alcohol dependence (Table 5).

Table 5. TCI-R differences between ADPs and control groups

	ADPs (n=81)	**Control** (n=166)	Statistics	p	Cohen's d
	Mean (SD)	Mean (SD)			
TCI-R factors					
NS	105.52 (15.82)	98.07 (14.93)	3.609	< 0.001	0.49[b]
HA	101.40 (16.70)	90.79 (20.05)	4.374	< 0.001	0.56[b]
RD	96.68 (11.27)	95.91 (15.09)		ns	
P	107.44 (17.04)	116.84 (17.61)	-3.972	< 0.001	0.54[b]
SD	131.85 (15.79)	145.65 (18.03)	-5.876	< 0.001	0.80[c]
C	125.47 (15.25)	130.32 (18.56)	-2.181	0.030	0.28[a]
ST	71.68 (14.36)	68.55 (15.57)		ns	

Note. ns indicates not significant. Relative size of Cohen's d: [a]small effect (<=-0.5 and >-0.15), [b]medium effect (>=0.50 and <0.75), [c]large effect (>=0.75 and <1.10)

To reveal the temperament and character background of the clinical symptoms of AD, partial correlation analysis was used (controlled for gender and age). Significant negative correlations were found between MAC-R and HA, and significant positive correlations between SADQ and NS, MAC-R and NS, MAC-R and P, APS and NS, AUDIT-LC and NS, AUDIT-C and NS, and AUDIT-T and NS (Table 6).

Table 6. Partial correlation (controlled for gender and age) between TCI-R factors and alcohol-related variables

	NS	HA	RD	P	SD	C	ST
Direct indicators							
SADQ_T	0.31**	-0.03	0.13	0.17	-0.20	-0.09	0.17
AUDIT_LC	0.30*	-0.01	-0.07	-0.15	-0.08	-0.20	-0.18
AUDIT_D	0.16	0.06	0.12	-0.04	-0.19	-0.04	0.15
AUDIT_C	0.29*	-0.14	0.03	0.07	0.02	-0.10	0.13
AUDIT_T	0.30*	-0.03	0.05	-0.04	-0.12	-0.13	0.06
Indirect indicators							
MAC-R	0.44**	-0.31**	0.07	0.28*	-0.05	-0.19	0.23
APS	0.27*	-0.14	0.20	0.08	0.02	-0.02	-0.03

* p<0.05, ** p<0.01

To find the strongest TCI-R predictor in the SADQ, AUDIT-T, MAC-R and APS, stepwise linear regression analysis was applied. In the regression model, age, gender, NS, HA, RD, P,

SD, C and ST were the independent variables and alcohol-related variables were the dependent variables. Besides the basic demographic variables (gender and age), NS proved to be the strongest predictor in the SADQ, MAC-R, APS and AUDIT-T (Table 7).

Table 7. Stepwise linear regression analysis to reveal the most powerful predictors of addiction severity indicators

Dependent variables	Included variables	Model coefficients			Model summary		
		Standardized β	t	p	Adjusted R^2	F	p
Direct indicators							
SADQ	Constant		1.290	0.201	0.064	6.312	0.014
	NS	0.275	2.512	0.014			
AUDIT_T	Constant		2.656	0.010	0.086	8.570	0.004
	NS	0.313	2.927	0.004			
Indirect indicators							
MAC-R	Constant		1.481	0.143	0.358	15.693	<0.001
	NS	0.464	5.007	<0.001			
	P	0.214	2.338	0.022			
	Gender	-0.212	-2.305	0.024			
APS	Constant		6.258	<0.001	0.123	11.806	0.001
	NS	0.367	3.436	0.001			

6.4. STUDY4: neurocognitive and personality determinants of long term alcohol abstinence

Sample G comprised 88 patients (N=43 STA and N=45 LTA). The basic characterization of the sample can be seen in Table 8.

Table 8. Demographic characterization of participants

	Short-term abstinence (STA)	Long-term abstinence (LTA)
	N=43	N=45
Age (years) mean(S.D.)	45.47(9.28)	51.51(7.58) **
Gender (M/F)	26 / 17	36/ 9*
Education (years) mean(S.D.)	13.51(3.10)	13.73(2.47)
IQ mean(S.D.)	115.4(10.47)	116.69(9.07)
VQ mean(S.D.	114.5(10.73)	116.91(10.68)
PQ mean(S.D.)	115.32(10.74)	115.42(11.06)
Last alcohol consumption in weeks mean(S.D.)	12.70(6.92)	327.82(165.57)* *
Age at first regular alcohol consumption mean(S.D.)	24.6(10.25)	24.21(10.86)
Duration of regular alcohol consumption in years mean(S.D.)	13.78(10.43)	14.38(8.16)

Note. **Significance threshold defined at p<0.01, *Significance threshold defined at $p < 0.05$., S.D.=standard deviation,

Group differences in IGT performance were tested by using two statistical approaches. MANCOVA was performed to compare IGT scores for each of the 5 blocks, with age as a covariate. The two groups did not differ significantly in DM performance ($F_{1,82} = 0.21$, p = 0.96) and age ($F_{1,82} = 0.98$, p= 0.43) nor gender ($F_{1,82} = 1.05$, p = 0.31) had an effect on the IGT performances. Furthermore, no significant interaction was found between group and gender. In addition to this, univariate ANOVA with linear trend analysis was performed for both groups to examine a possible learning effect improving DM efficacy along the 5 IGT blocks. No marked linear improvement in IGT performance was observed in either group (STA $t_{4,210} = 0.661$, p = 0.509 and LTA $t_{4,220} = 1.461$, p = 0.146). Neither of the groups managed to acquire an advantageous DM strategy in the course of the IGT, resulting in a consistent performance at the chance level (Fig. 2). This pattern of results confirms that the DM impairment in AD is stable with the IGT performance not significantly better than chance. This is indicated by the mean DM capacity scores remaining around zero.

We did not find any significant correlation between IGT performance and alcohol consumption-related variables in the exploration of the effect of AD severity on DM in either

group (a) age at first regular alcohol consumption: STA ($r = -0.11$, p $= 0.518$) and LTA ($r = -0.09$, p$= 0.543$) (b) duration of regular alcohol consumption in years: STA ($r = -0.294$, p $= 0.077$) and LTA ($r = -0.165$, p $= 0.308$). These results indicate that there is no marked worsening in DM performance with increased AD severity.
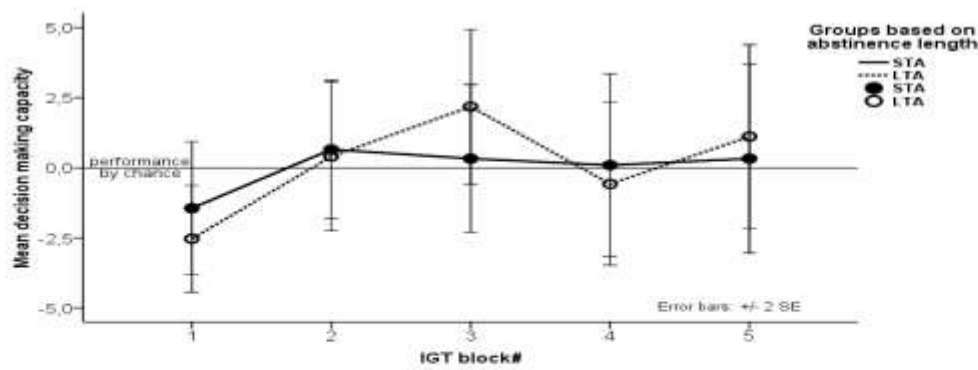

Figure 2. Average scores of decision making (DM) capacity in the Iowa Gambling Task (IGT) blocks. The short term abstinence (STA) and long term abstinence (LTA) groups did not differ significantly in their DM performance (MANCOVA, $F_{5,78}=0.21$, p=0.96). Furthermore, no learning effect was present as indicated by consistent performance at chance and no significant linear improvement in DM efficacy along the five IGT blocks for both groups (univariate ANOVA with linear trend analysis, STA $t_{4,210}=0.661$, p=0.509 and LTA $t_{4,220}=1.461$, p=0.146).

For a better understanding of the dimensions that differentiate between the LTA and STA groups, TCI-R scales were examined and significant differences were found in three measures. The LTA group achieved markedly higher scores on scales of SD ($F_{1,85}=24.73$, p<0.001, observed power=0.99,) and C ($F_{1,85}=8.314$, p=0.005, observed power=0.81) (Table 2), while the STA group scored significantly higher on the HA scale ($F_{1,85}=4.17$, p=0.04, observed power=0.52). No significant effect of age on these TCI-R scores of interest was found. Interactions between gender and groups were not significant. An analysis of observed power revealed that SD is the most powerful contributor to LTA ability (Table 9).

Table 9. Differences in personality measures (TCI-R) between STA and LTA groups

	Group effect				F statistic	P value
	STA		**LTA**			
	Mean (S.D.)		Mean (S.D.)			
NS	107.09	(17.77)	96.39	(10.83)	2.74	NS
HA	99.12	(17.81)	88.7	(14.71)	4.17	0.04
RD	97.79	(12.66)	97.77	(11.14)	0.48	NS
P	108.58	(17.03)	113.45	(15.07)	2.99	NS
SD	132.6	(15.69)	149.84	(12.49)	24.73	<0.001
C	126.07	(16.22)	136.48	(12.31)	8.31	0.005
ST	75.58	(14.57)	81.27	(12.12)	1.12	NS

NS= not significant

6.5. STUDY5: Recovery from AD: 12 step and the role of spirituality

Sample H comprised 169 patients from 3 different treatment settings named as: detoxification group (DTG), therapeutic community group (TCG) and Alcoholics Anonymous Groups (AAG). The differences between the groups were evaluated on the basis of demographic and alcohol-related variables. Furthermore, the level of anxiodepressive symptoms and spirituality were evaluated. Significant differences were found between the groups in terms of age, years of education, and alcohol consumption related variables (Table 10). The number of years spent in education was the lowest in the DT group. Regular alcohol consumption was started at a significantly younger age in TCG (MW=1087.0, p=0.029) and AAG (MW=476.0, p=0.006), as compared with the DTG, but no significant differences were found between TCG and AAG (MW=1665.5, p=0.264). TCG had significantly higher AUDIT Total (MW=1092.5, p=0.017) scores than DTG. Furthermore, different treatment approaches showed different levels of spirituality, anxiety and depressive symptoms (Table 10).

Table 10. Demographic characterization and treatment group differences on the TCI-R-ST, BDI, STAI-S, STAI of the participants

	DTG N=34	TCG N=89	AAG N=46	Group comparison
Age *Mean (SD)*	41.76 (9.20)	44.37 (9.07)	51.33 (7.59)	$F(2)=14.06$, $p \leq 0.001$[a]
Gender *Male N (%)*	25 (74)	55 (62)	36 (78)	$\chi^2(2)=4.29$, $p=0.117$[b]
Education *(years) mean (SD)*	12.32 (2.3)	13.08 (2.78)	13.67 (2.47)	$KW(2)=7.03$, $p=0.030$[b]
Age at first consumption *Mean (SD)*	28.18 (8.71)	24.57 (9.55)	24 (10.82)	$KW(2)=8.10$, $p=0.017$[b]
Time since last consumption in weeks *Mean (SD)*	0.85 (0.50)	15.84 (19.24)	319.14 (160.05)	$KW(2)=134.13$, $p<0.01$[b]
AUDIT *Mean (SD)*	27.65 (6.24)	30.57 (7.05)	0	$KW(2)=105.08$, $p \leq 0.001$[b]
State Anxiety (STAI) Mean(SD)	42.73 (*11.07*)	37.87 (*10.56*)	29.71 (*7.55*)	$F(2,164)=17.76$, $p \leq 0.001$[a]
Trait Anxiety (STAI) Mean(SD)	51.03(*6.87*)	46.69 (*6.88*)	37.91(*7.57*)	$F(2,162)=36.69$, $p \leq 0.001$[a]
Depressive symptoms (BDI) Mean(SD)	15.82 (*9.97*)	10.54 (*7.34*)	5.91 (*5.41*)	$F(2,160)=16.89$, $p \leq 0.001$[a]
Spirituality (TCI-R) Mean(SD)	65.18 (*12.20*)	76.55 (*14.35*)	81.31 (*11.99*)	$F(2,163)=14.41$ $p \leq 0.001$[a]

In the mediation analysis, the treatment effect was tested on mental health outcome such as depression, trait and state anxiety. Both the TCG with a lower spirituality component and AAG with a stronger spiritual component had significant direct effects on depression as well as on trait anxiety and state anxiety as compared with the DTG without any formal spiritual component. However, the indirect mediating effect of spirituality was significant only in the case of state anxiety.

Table 11. Standardized estimates of total, direct and indirect effects of treatment on depression and anxiety

	Outcome variables	Total treatment effect β (p)	Direct treatment effect β (p)	Indirect treatment effect β (p)
Minnesota model – low spirituality	*Depression*	**-0.32 (.003)**	**-0.29 (.012)**	-.03 (.324)
	Trait Anxiety	**-0.28 (<.001)**	**-0.24 (.003)**	-0.04 (.170)
	State Anxiety	**-0.23 (.022)**	-0.14 (.207)	**-0.09 (.005)**
12-step approach – high spirituality	*Depression*	**-0.55 (<.001)**	**-0.51 (<.001)**	-0.04 (.321)
	Trait Anxiety	**--0.68 (<.001)**	**-0.63 (<.001)**	-0.05 (.152)
	State Anxiety	**-0.60 (<.001)**	**-0.48 (<.001)**	**-0.12 (.001)**

Note: Indirect effect estimates the size of the treatment → spirituality →outcome variable mediation. Age, gender and education are controlled in the analysis. Boldfaced estimates are significant at least at .05.
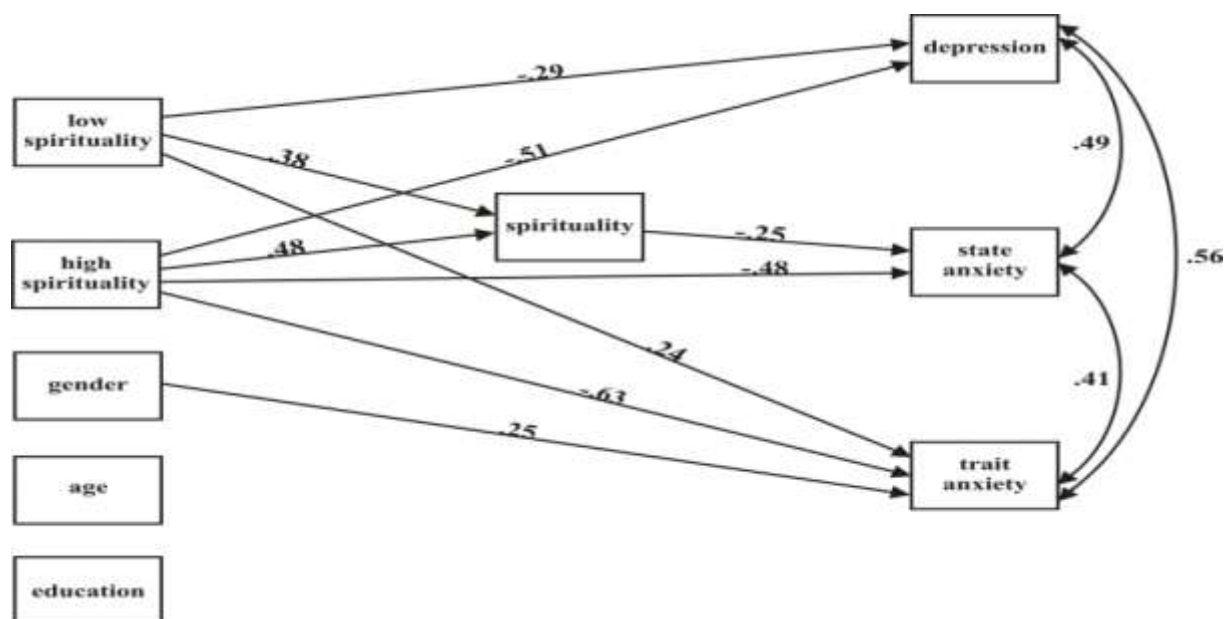
Figure 3. The final model with standardized estimates on the mediation effect of spirituality. Note: The model describes the associations between treatment characteristic, spirituality and outcome variables. Two dummy variables (low and high spirituality, coded 0 and 1) are applied to code three treatment groups. Only the significant paths are presented here for the sake of clarity. Age and education were controlled in the equation.

7. Discussion

This study had multiple aims. Psychometric indices were presented for clinical tests and the major focus was on addiction related-measures. Indirect and direct AD severity indicators were evaluated psychometrically and in the light of the biosocial personality model. Furthermore, as a result of the multifaceted nature of AD, complex psychological assessments including personality and specific neurocognitive correlates were determined along the course of this disorder.

By using the short form of the SSS, it was demonstrated that the test psychometric indices are dependent on the sample, confirming the idea that a psychometric test can be more reliable under one condition than under another (Hungarian representative sample vs. mixed clinical sample) (Gilbody et al., 2006). The determination of the number of test items is crucial. In this work, a new short questionnaire for measuring the sensation-seeking trait is presented: the SSS-7-HU. This psychometric measure shows the best reliability indices in the case of 7

items. Widely used screening tests such as the AUDIT and EPDS contain internationally determined 10 items. An important issue is the assessment of the balanced internal consistency of the 10 items, measured by the role of each item in the total scale. Furthermore, it should be emphasized that these measures directly affect the treatment of individuals (NICE 2011, Kozinszky and Dudás, 2015), in contrast with the SSS-7-HU, which is mainly used for research purposes. In principle, screening tests used in clinical practice must have excellent psychometric properties. The results indicate that the AUDIT and EPDS have similar, but better reliability indices than the SSS-7-HU, though the latter can also be regarded as optimal. As may be seen from the case of the SSS-7-HU, the pattern of the reliability indices can differ on different samples. However, the case of the EPDS is different. It was validated on different samples; antepartum (Töreki et al., 2013) and the results of the present work reveal similar excellent reliability indices on post partum sample too. It can therefore be concluded that the psychometric indices of this measure are robust. Similarly to the EPDS, the internal consistency characteristics of the AUDIT are also outstanding. The AUDIT has already been validated on a large Hungarian sample (Rózsa et al., 2003); in addition, this study confirms its optimal psychometric properties on a clinical sample. Another direct addiction severity indicator, the SADQ, is also recommended in international alcohol treatment protocols (e.g. NICE 2011). As far as we are aware, no Hungarian data are available regarding the psychometric properties of the SADQ. The results of this work indicate that the SADQ is a reliable and valid measure for the assessment of symptom severity in AD. The SADQ possesses optimal internal reliability and convergent validity indices. However, it must also be emphasized that more examinations are needed on different Hungarian samples for a more accurate psychometric characterization of this essential psychometric measure.

It is well known that all MMPI-2 scales are extensively studied psychometrically. This study focused on the addiction scales (MAC-R, APS and AAS) of the MMPI-2 and confirmed that these indirect severity measures are valid in the detection of patients with AD. It is clear from the results that all the dependency scales have acceptable diagnostic sensitivity, although the combination of these three measures gives the best sensitivity and specificity values. This is in accordance with the clinical application of MMPI-2 since the whole scale is administered typically.

This work also identified the temperament and character factors related to AD and revealed the most powerful personality determinant of AD measured by the TCI-R. Furthermore, multiple symptom severity measures (the AUDIT, SADQ, MAC-R and APS) were used to reveal the relationships between the symptomatology of AD and personality structure.

The temperament and character factors indicated that ADPs display characteristic differences as compared with healthy controls. A higher level of NS and a lower level of SD were found among ADPs, with no significant difference in temperament RD. These results are in accordance with the findings of Basiaux et al. (2001) and le Bon et al. (2004). This pattern of NS and SD indicates that AD is connected with more pronounced impulsivity, extravagance and irritability, together with a pessimistic, shy and fatigueable composition.

In the TCI, P was measured with one short scale only and no difference was found between the controls and ADPs (le Bon et al., 2004, Basiaux et al., 2001), while in the TCI-R P is an elaborated temperament dimension, with 35 items and 4 subscales. The study with the TCI-R demonstrated that P is lower in ADPs. A lower temperament P indicates a lower level of ambition and perfectionism and a higher level of inertness among ADPs.

The greatest difference between the two groups was found in the character factor SD indicated by Cohen's d. This strong relationship between AD and SD reveals that ADPs have less ability to control and maintain goal- and value-oriented behaviour. A significantly lower score for C was found among ADPs, indicating hostile, revengeful and opportunistic characteristics (Svrakic et al., 2002, Cloninger et al., 1993). Lower scores for SD and C are associated with a higher risk of symptoms of personality disorders (Svrakic et al., 2002).

The results also revealed that temperament and character factors are related to the complex symptomatology of AD, measured by means of both direct and indirect severity measures. Among the personality factors assessed, a key role in the understanding of the direct severity indicators of AD is played by NS, since only this factor is connected with these severity indicators. NS determines different symptoms of addiction: the SADQ, as an indicator of the psycho-biological withdrawal phenomena, correlates positively with NS. An elevated NS is connected with an elevated consumption level (AUDIT-LC) and the adverse consequences of drinking (AUDIT-C). In summary, a higher NS is associated with a greater severity of alcohol-related problems and AD (AUDIT-T and SADQ).

The mild and medium positive correlations between NS and the indirect indicators of severity (APS and MAC-R) show that a higher NS accompanies a greater risk of the development of lifestyle and personality characteristics related to addictive behaviour. ADPs with higher MAC-R scores are more likely to be characterized by antisocial features and can be associated with the Cloninger type II earlier-onset AD (Svanum and Ehrmann, 1992). In this study, a higher HA was negatively associated with the MAC-R score, indicating that HA is negatively related to the antisocial characteristics of AD. A higher HA and a lower MAC-R score are associated with the Cloninger type I later onset AD, which is characterized by an anxious personality.

The significant positive correlation between P and the MAC-R score indicates that ADPs with higher P demonstrate more pronounced antisocial characteristics and a higher tendency to risk-taking and social drinking (Svanum and Ehrmann, 1992). NS is one of the most powerful predictors of future alcohol abuse in adolescents (George et al., 2010) and it determines heavy drinking patterns in the teenage years (Laucht et al., 2007). NS is connected with the age at onset of regular alcohol use (Cloninger et al., 1981), is higher among ADPs (le Bon et al., 2004, Basiaux et al., 2001) and is an important predictor of relapse (Meszaros et al., 1999). This study has revealed that (among the temperament and character factors) NS is the strongest correlate of the severity of the clinical symptomatology of alcohol addiction in ADPs. This personality factor is the most powerful determinant of a severe AD and a higher level of alcohol intake. Moreover, this temperament dimension is strongly associated with the indirect severity indicators, showing that a higher NS is connected with a higher addiction potential. It is proposed that the impulsivity variables (e.g. NS) could be the link between the genetic risk and the clinical manifestation of alcohol use disorders (Verdejo-García et al., 2008) since the construct of impulsivity may meet the core criteria of the psychiatric disorder endophenotype suggested by Gottesman and Gould (Gottesman and Gould 2003) . The present research indicates that the temperament dimension NS is the most powerful determinant of the complex addiction severity indicators. As frontal lobe-related neurocognitive functions are emphasized in impulse control disorders, the investigation of related personality traits in combination with neurocognitive test batteries could further promote the appropriate characterization of ADPs. These associations could help identify and screen out patients with severe alcohol-related problems through use of the TCI-R. This

approach has implications for clinical routine and might improve the efficacy of treatment by shedding light on the relation between individual differences and symptom severity. Depending on the substance abused, specific personality profiles could be revealed; therefore, future research shall focus on other forms of dependences in connection with symptom severities.

For a further understanding of AD long-term abstinent patients were evaluated. The complex nature of addictive behaviour demands an integrative research approach combining neuropsychological and personality measures. Besides TCI-R factors, IGT, a neurocognitive indicator of DM was administered. The comparison of ADPs at the beginning of the recovery process with patients managing to maintain long-term abstinence allows assessing the associations of DM abilities and personality factors with abstinence length. The findings provide new evidence of a persistent DM deficit in AD. This work demonstrated the impairment by using IGT, which models real-life DM strategies influenced by reward and punishment contingencies. AD is a chronic condition characterized by a high relapse rate. While relapses are considered to be part of the recovery process, relapse prevention is of indisputable importance and a key determinant of long-term abstinence. Unfortunately, many ADPs fail to maintain prolonged abstinence. This phenomenon might be due to a DM deficit manifested in the lack of an advantageous long-term strategy, strongly influenced by immediate reward preference disregarding future negative consequences. According to recent research findings, disadvantageous DM skills are persistent in AD, as captured in impaired IGT performance in LTA (Fein et al., 2004). This deficit might be linked to a global executive function disturbance in AD. However, most neuropsychological measures were typically found to improve with the duration of abstinence (Fein and McGillivray, 2007, Fernández-Serrano et al., 2010) with the exception of spatial processing (Fein et al., 2006) and DM. This makes it unlikely that disadvantageous DM strategies in alcoholism are due to a general executive impairment. The current study complements previous reports and provides novel evidence for the trait-like DM impairment in AD. The maladaptive DM strategy strongly influenced by immediate reward preference and disregarding long-term negative consequences is similarly present at the beginning and after several years of abstinence. The IGT performance of both the STA and LTA groups was not significantly better than chance, as indicated by mean DM capacity scores consistently around zero. Any effects of

psychotropic medication on DM performance can be excluded, since all patients were unmedicated at the time of participation. The intact global cognitive status of participants was ensured by the inclusion criteria of an IQ above 90. Furthermore, the similar age of onset and years of regular alcohol consumption in the two groups allowed us to investigate the effects of AD severity on DM strategies. The results indicated that there is no marked worsening in DM performance with increased AD severity. This is in accordance with the earlier findings of Fein et al. suggesting that the lifetime alcohol intake is independent of the neuropsychological functioning (Fein et al., 1990). Moreover, repeated withdrawal was found to have only a minimal impairing effect on the prefrontal function (Loeber et al., 2009). Previous studies focusing on neurocognitive correlates of substance dependence reported that the IGT is a useful predictor of maladaptive alcohol use among college students. Advantageous decision makers appear to show future adaptive real-life DM, adjusting their drinking habits to lifestyle changes, whereas disadvantageous decision makers do not and continue to drink heavily (Goudriaan et al., 2011), a pattern independent of impulsivity (Goudriaan et al., 2007). These convergent lines of evidence indicate that DM impairment is either affected earlier in dependence or already present as a predisposing factor to alcoholism. Despite persistent DM deficits, ADPs can achieve long-term abstinence (Fein et al., 2010b). This raises the possibility of other influencing factors that compensate for the non-adaptive executive strategy. Here the major personality determinant of AD in relation to abstinence length was studied: the biosocial personality model. There is extensive support for a link between specific personality dimensions and AD. High levels of sensation-seeking were found to serve as vulnerability factors to substance abuse (Zuckerman, 1994, Hittner and Swickert, 2006), while lower levels increase the ability to maintain prolonged abstinence (Fein et al., 2010b). However, according to Franques et al., sensation-seeking is probably irrelevant to continued substance use after dependence develops (Franques et al., 2000). HA and anxiety-related personality traits also serve as vulnerability candidates for addictive behaviour (Sher et al., 1995). The LTA group studied here achieved markedly higher scores on scales of SD and C. In addition, lower levels of HA were measured. The integration of these temperament and character dimensions results in a more adaptive personality profile with less probability of personality disorders (Svrakic, 2002). Furthermore, these favourable features serve as indicators of a better therapeutic evaluation and outcome (Arnau et al., 2008). It was found

that SD is the most powerful predictor of LTA. This indicates higher levels of autonomy, reliability, responsibility and maturity. Additionally, as this work revealed, this character factor of the biosocial personality model is the most powerful contributor to "actual" AD too. The compensatory factors described here might potentially be explained by a normalization process related to treatment in AD (based on 12 steps), or represent a predisposition to long-term abstinence. This raises a number of other questions concerning the interaction of personality traits with the ability to sustain long-term sobriety. It can be speculated that STA patients may increase their likelihood to maintain abstinence, provided that they are capable of developing and expanding some of the presumably effective compensatory strategies supported by targeted treatment. Future-dedicated studies are greatly needed to explore causality by employing a longitudinal study design. A limitation can be the relatively small sample size. Another potentially conflicting question emerges regarding the mental health history and treatment characteristics of the patient samples. STA patients were inpatients in an anti-alcohol treatment programme based on the MM at the time of the study. The LTA patients on the other hand had not consumed alcohol for several years, and attended AA at the time of participation as outpatients. The participants received no psychotropic medication and were screened for psychiatric co-morbidities unrelated to alcohol consumption. Thus, the aim was to focus on specific effects of AD and abstinence sustenance on neurocognitive and psychosocial mechanisms, while narrowing the influence of potentially confounding factors. Diagnoses related to AD were allowed, approaching real-life like circumstances, as far as possible. However, it must to be emphasized, that the patients involved in this study may not be representative of the AD patient population in general, affected by several co-morbidities or requiring ongoing inpatient treatment. In summary, it is proposed that the more adaptive personality profile of the LTA patients described here contributes to the compensation of the trait-like DM deficit in AD. An integrative approach in the assessment of the ability to achieve and maintain prolonged abstinence opens new perspectives for therapeutic interventions and supports targeting-specific preventive measures to reduce the risk of relapse. The long-term abstinence described here was achieved by regular 12-step-based AA attendance. The level of spiritual orientation is an important component for the 12-step-based treatments of AD, therefore in this work it was operationalized by the ST character factor of the Biosocial Personality Model.

Spirituality, a major component of 12 step based AD treatments was assessed in relation to anxiodepressive symptoms in three different formal alcohol treatment models. These treatment models incorporate spirituality differently: during the detoxification phase the spiritual component of the formal treatment is not present, while in the rehabilitation phase (1-4 steps) and in AA groups (1-12 steps) patients complete "step-work". The results confirmed that detoxification treatment, long term (12-step-based) therapeutic community treatment, and at least 3 years of AA attendance differed significantly in terms of the experienced level of spirituality by the patients. The patients in long-term 12-step-based rehabilitation and in sustained AA attendance displayed more pronounced spirituality than those in detoxification treatment. Our results also confirmed that the three different treatment models differed significantly according to the anxiety and depressive symptoms showed by the patients. In accordance with earlier findings (Araujo et al., 1996, Brown et al., 1991) more pronounced anxiodepressive symptoms occurred in the detoxification phase, while these symptoms were lower in the therapeutic community treatment, and the lowest among the long-term abstinent AA group members. The major finding is confirmation that spirituality is a mediating factor within the treatment and, as such, decreases state anxiety. This mediation was not detected, however, in the case of either depressive symptoms or trait anxiety. These results therefore emphasize the beneficial acute effect of the spiritual domain in the context of 12-step-based interventions, but it seems that this effect can be maintained only by regular attendance, as spirituality does not seem to play any mediating role in the reduction of trait anxiety. On the other hand, other components of the long-term therapeutic community treatment and of the AA attendance contribute significantly to the reduction in depressive symptoms and trait anxiety. A question for future research is what components could be responsible for these favourable effects. Since higher anxiety is a potential risk factor for relapse in substance use disorders (self-medication theory of substance dependence) (Smith and Book, 2008), interventions applying spirituality could help relapse prevention, as a result of its potential reduction effect on state anxiety. In conclusion, in the context of 12-step-based interventions, the enhancement of spiritual orientation could be a favourable treatment aim for ADPs. Some limitations are to be emphasized. Due to the quasi-experimental nature of this study, further randomized and follow-up studies are needed to clarify the interrelationship between the spiritual orientation and mental health status indices. Furthermore, 12-step-based

treatments are not applicable for every patient with alcohol problems. There is a great deal of heterogeneity within the diagnostic group of AD and there is no treatment approach that is suitable for everyone. Therefore, this mediation effect of spirituality can only be interpreted in the case of patients who are able to engage in mutual self-help groups based on the 12 step. Another limitation is the fact that spirituality is a heterogeneous concept and in this study it was assessed by only one scale.

8. Conclusions

In this study the course of AD was assessed by using psychometric tests in order to further understand the course of AD. Validated symptom severity indicators were connected with personality factors to extend our knowledge on patients with more severe forms of addiction, while the ability to maintain abstinence was assessed by an integrative approach.

Systematic psychometric analyses have been conducted in Hungary only in recent years and the present thesis set out to ameliorate this. This work presents the SSS-7-HU, a new short test for measuring the sensation-seeking trait. Through this measure, the idea was confirmed that a psychometric test can be more reliable under one condition than under another. Screening tests used in clinical practice must have excellent and robust psychometric indices. The EPDS has optimal psychometric indices on a large Hungarian sample (Nagy et al., 2011) and excellent reliability indices for the antepartum (Töreki et al., 2013) and the postpartum period on clinical sample. The psychometric properties of the AUDIT show a similar pattern. Rózsa et al. (2003) observed excellent psychometric properties on a large Hungarian sample, and the present work has demonstrated the optimal reliability and validity indices on a clinical sample. Another direct addiction severity indicator is the SADQ. Based on our literature review no Hungarian data are available on the psychometric properties of this measure. It can be concluded from the results that SADQ is a reliable and valid measure in Hungary for the assessment of symptom severity in AD. This study also focused on indirect addiction severity indicators (MAC-R, APS and AAS) of the MMPI-2. It was confirmed on a Hungarian sample that all dependency scales have acceptable diagnostic sensitivity, and the combination of these three measures gives the best sensitivity and specificity values.

ADPs display characteristic personality differences as compared with healthy controls. The most powerful contributor to AD is the SD character factor of the biosocial model, which indicates less ability to control and maintain goal-oriented behaviour. The results also revealed that temperament and character factors are related to the complex symptomatology of AD; NS is the strongest correlate of the severity of the clinical symptomatology of AD. Furthermore, this personality factor is the most powerful determinant of severe AD and a higher level of alcohol intake.

Decision-making deficit is detectable even after long-term alcohol abstinence. This finding of Fein et al (2004) was confirmed and supplemented with the fact that this phenomenon occurs with an intact global cognitive status. Despite persistent DM deficits, ADPs can achieve long-term abstinence. A more adaptive personality profile and SD, which is the most powerful predictor of LTA, can contribute to the compensation of this trait-like neurocognitive deficit. It can be concluded that SD character factor is a major personality determinant of the „actual" AD and in the maintenance of alcohol abstinence.

Three distinct alcohol treatment models were assessed; detoxification treatment, long-term (12-step-based) therapeutic rehabilitation treatment and Alcoholics Anonymous group. Our results confirmed that the three different treatment models differed significantly according to the anxiety and depressive symptoms. The main finding is that spirituality is a mediating factor within the treatment and, as such, it decreases state anxiety. In the context of 12-step-based interventions, the enhancement of spiritual orientation could be a favourable treatment aim for ADPs.

The assessment of psychometric indices in the field of addiction is crucial. A complex approach is more informative and could further help to form individualized treatment for patients with AD.

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